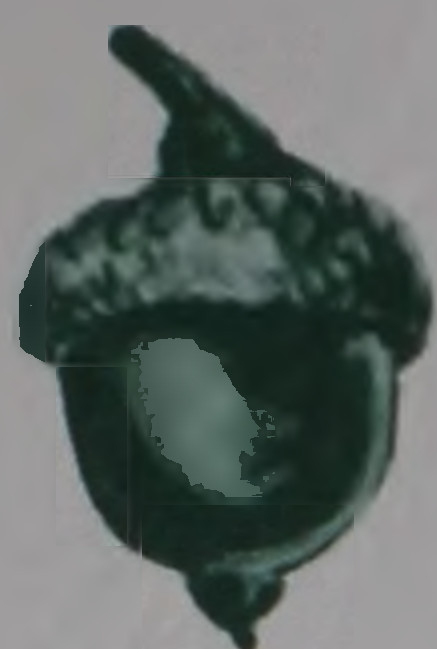


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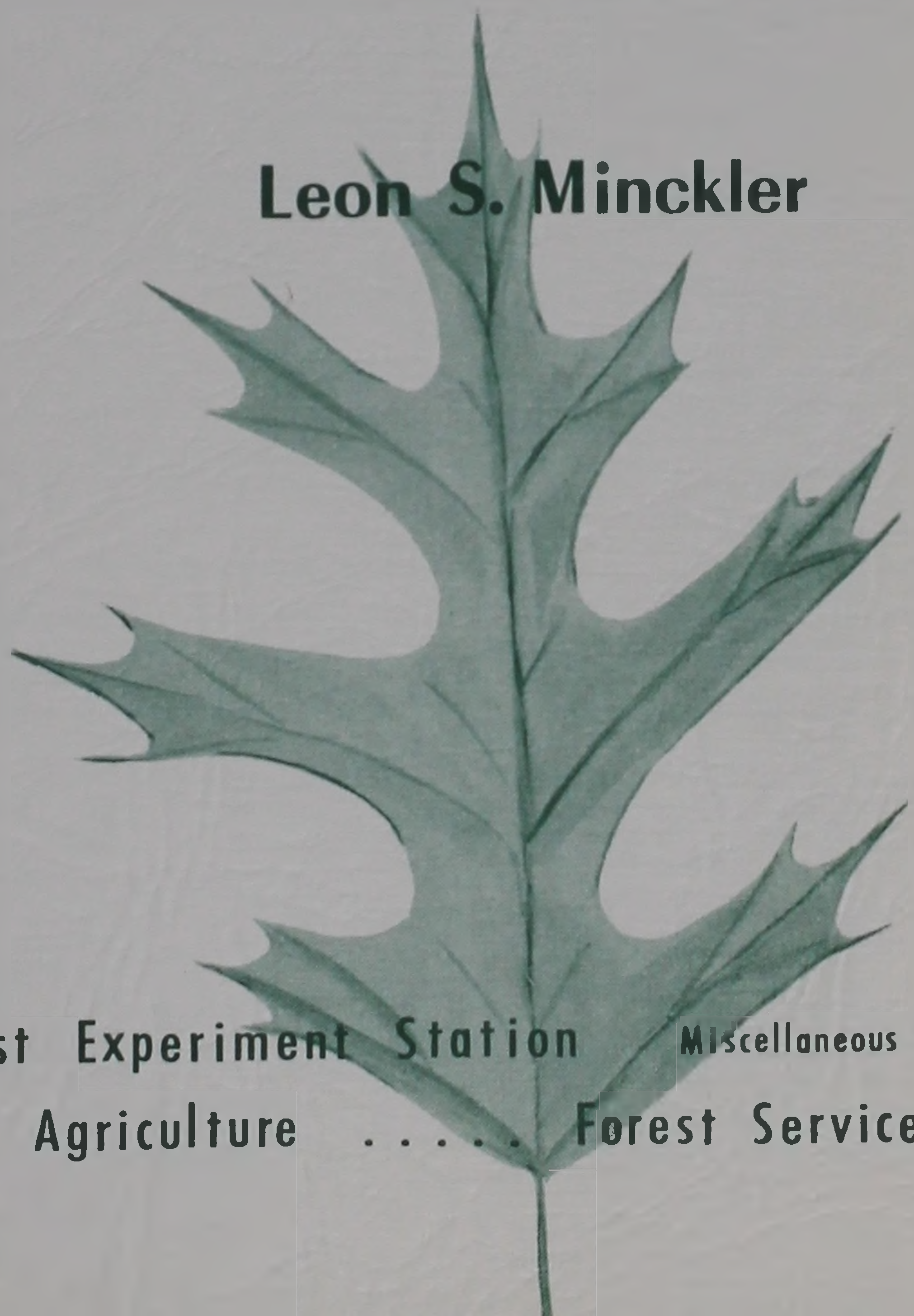
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SILVICAL CHARACTERISTICS of PIN OAK



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Reaction to Competition

Pin oak is intolerant of shade. It is less tolerant than such associated species as elm, boxelder, sweetgum, hackberry, and ash but more tolerant than cottonwood and willow. Seedlings will live only 2 or 3 years under full crown shade. The more vigorous seedlings in partial shade will respond quickly when fully released. Response to thinning in fully stocked stands is immediate and rapid (5). In even-aged, pure stands, dominant and codominant trees tend to develop a full canopy and to overtop trees in the intermediate crown class. Once overtopped, these trees live only a few years. Isolated trees in mixed stands are usually dominants.

Pin oak usually produces many lower limbs; hence its pyramidal shape when growing in the open. In closed stands these lower limbs, however, die soon after they are shaded by the crowns. The dead limbs are very tough and persistent, remaining on the trunk for many years and giving rise to many pin knots in the lumber, thus giving the tree its common name.

Pin oak is usually considered to be a sub-climax species (8). It does persist, however, for long periods on heavy, wet soils. It is not difficult to maintain on such sites because it produces an abundance of seed and grows faster here than any other species. If given enough freedom from overhead shade it will usually pre-empt these sites preventing the climax type from developing.

Figure 2.--The profusion of lower limbs on pin oak result in many "pin" knots in the lumber.



ENEMIES AND HAZARDS

Because of its thin bark, pin oak is more susceptible to fire injury than most other oaks. Heartwood decay entering through fire scars is by far the most serious disease of pin oak. Fires seldom occur in the spring and winter but conditions in the fall are often ideal for severe fires. Hot, ground fires often will kill trees up to sawtimber size.

There are no animals especially associated with pin oak, although the acorns are an important source of food for waterfowl, deer, and squirrels (4). Shallow flooding during periods in the fall and winter, together with the fact that the trees produce small acorns, make pin oak stands excellent forage grounds for waterfowl (chiefly ducks) that feed under water. In southeastern Missouri, such habitats have been deliberately created by the Conservation Commission. Locally, pin oak flats are often called "crawdad" land because of the occurrence of crayfish mounds on the tight, blue-gray soil.

The oak wilt disease caused by the fungus Ceratocystis fagacearum has so far not been reported in pin oak stands. So far as is known, however, pin oak is susceptible to oak wilt and hence subject to great losses if this disease should become epidemic.

Several cankers occur on pin oak, the most important of which is the Dothiorella canker (Dothiorella quercina) (1). This can cause dieback of branches but is seldom serious. Leaves of pin oak may have minor infections of various blisters and rusts. None of these are important. Shade trees sometimes develop a chlorosis when growing on neutral or alkaline soils. This is because iron is less available to plants in soils with high pH.

There are no important insect enemies of pin oak except, possibly, some of the wood borers associated with oaks. These may damage the wood of standing trees and thus cause log and lumber defects. Wood borers usually attack only weakened trees.

RACES AND HYBRIDS

Like all the oaks, pin oak hybridizes readily. Four hybrids have been recognized and described (3). These are probably very rare. No definite races have been defined but climatic races probably do exist in the wide range of this species. As for all species of Quercus wide fluctuation in growth habit occurs in different places and usually it is not possible to determine whether these are caused by site differences, races, hybridization, or a combination of all three.

SPECIAL FEATURES

The most characteristic special feature of pin oak is the persistent, small, drooping dead branches along the trunk and the resulting pin knots in the lumber. Related to this characteristic is the pyramidal shape of the crown when growing in the open. Because of its attractive shape; its relative resistance to smoke, fumes, and glaze damage; ease of transplanting; and its ability to grow well even on relatively dry clay soils; it is a favorite shade tree in yards and streets.

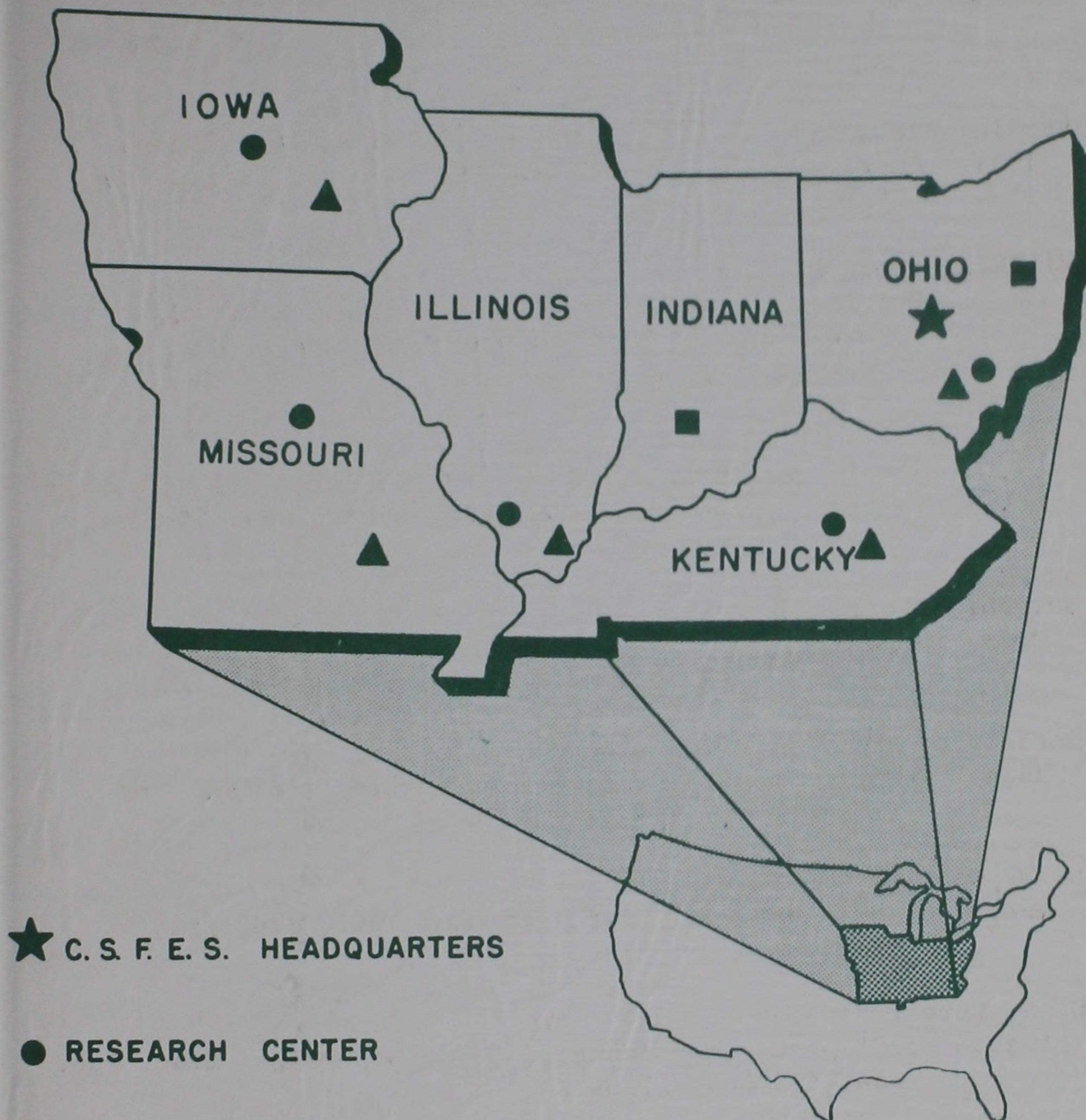
TREE SPECIES MENTIONED

Green ash	-	<u>Fraxinus pennsylvanica</u> Marsh.
American beech	-	<u>Fagus grandifolia</u> Ehrh.
River birch	-	<u>Betula nigra</u> L.
Boxelder	-	<u>Acer negundo</u> L.
Eastern cottonwood	-	<u>Populus deltoides</u> Bartr.
Elms	-	<u>Ulmus</u> spp.
Hackberry	-	<u>Celtis occidentalis</u> L.
Honeylocust	-	<u>Gleditsia triacanthos</u> L.
Red maple	-	<u>Acer rubrum</u> L.
Bur oak	-	<u>Quercus macrocarpa</u> Michx.
Cherrybark oak	-	<u>Q. falcata</u> var. <u>pagodaefolia</u> Ell.
Northern pin oak	-	<u>Q. ellipsoidalis</u> E. J. Hill
Overcup oak	-	<u>Q. lyrata</u> Walt.
Pin oak	-	<u>Q. palustris</u> Muenchh.
Swamp white oak	-	<u>Q. bicolor</u> Willd.
Willow oak	-	<u>Q. phellos</u> L.
Sweetgum	-	<u>Liquidambar styraciflua</u> L.
Waterlocust	-	<u>Gleditsia aquatica</u> Marsh.

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This is the sixth of a series of 17 papers dealing with silvical characteristics of forest trees important in the Central States region. The following species are included in this series. (Those marked with an asterisk have already been published.)

- *Ohio buckeye
- Yellow buckeye
- *Northern red oak
- *Black oak
- Chinkapin oak
- *Pin oak
- White oak
- Swamp white oak
- Bur oak
- Butternut
- Black walnut
- *Shellbark hickory
- Sycamore
- Honeylocust
- Hackberry
- Black locust
- *Eastern redcedar

Papers covering additional important American species will be issued by other Forest Experiment Stations of the U. S. Forest Service.

Central States Forest Experiment Station, U. S. Dept. of Agriculture
Forest Service, 111 Old Federal Building, Columbus 15, Ohio
W. G. McGinnies, Director

November 1957



Silvical Characteristics

of Pin Oak

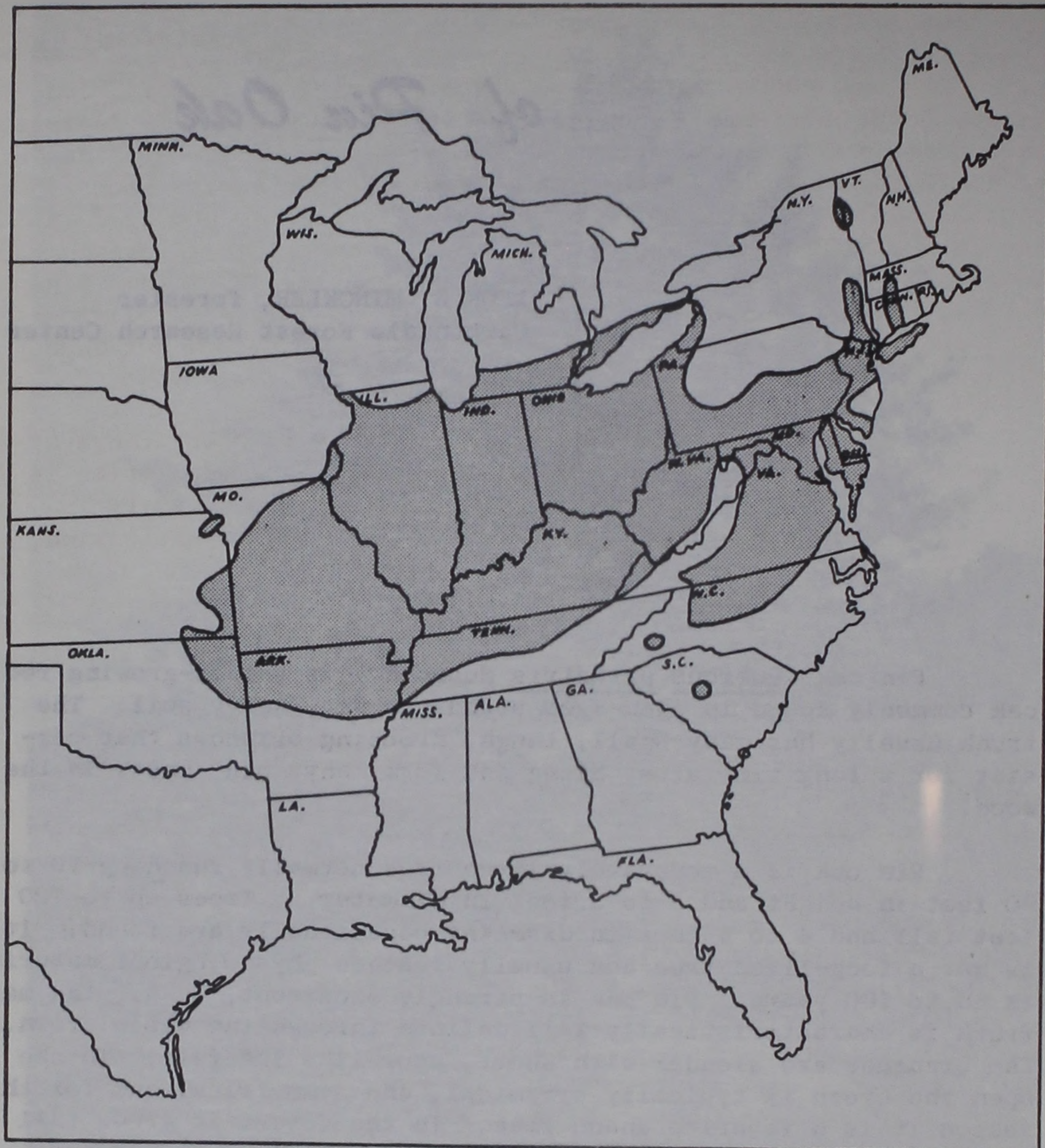
LEON S. MINCKLER, forester
Carbondale Forest Research Center

Pin oak (Quercus palustris Muenchh.) is a fast-growing red oak commonly found in even-aged stands on wet, heavy soil. The trunk usually has many small, tough, drooping branches that persist for a long time after dying and form many "pin" knots in the wood.

Pin oak is a moderately large tree normally reaching 70 to 90 feet in height and 2 to 3 feet in diameter. Trees up to 120 feet tall and 4 to 5 feet in diameter occasionally are found. It is not a long-lived tree and usually reaches physiological maturity in 80 to 100 years. Pin oak is strongly excurrent, i. e., the main trunk is characteristically well defined through the whole crown. The branches are slender with short, spur-like laterals. In the open the crown is typically pyramidal, and symmetrical and for this reason it is a favorite shade tree. In the forest it grows tall and straight and the generally pyramidal crown is much narrower.

Other common names are Spanish oak, swamp oak, and swamp Spanish oak. Locally it is sometimes called water oak. Pin oak is not to be confused with northern pin oak (Quercus ellipsoidalis E. J. Hill), a much less important tree generally occurring just north of the range of pin oak.

DISTRIBUTION



Pin oak occurs generally in the Middle Atlantic states, the Ohio Valley, and the state of Missouri. The chief commercial range is the lower Ohio Valley, the Mississippi Valley adjacent to Illinois and Missouri, and along the major drainages in Missouri, especially in the southeastern lowlands (2, 7)¹/

¹/ Numbers in parentheses refer to Literature Cited, p. 10.

HABITAT CONDITIONS

Climate

Pin oak occurs in a moderately wide range of climatic conditions. The mean annual temperature varies from about 50 degrees Fahrenheit in Connecticut to about 60 degrees in North Carolina and northern Arkansas. Mean annual precipitation varies from about 50 inches in the southern part of the range to about 35 inches in the northwestern part. The average noon July relative humidity is less than 50 percent in the western part of the range and more than 65 percent on the east coast. The frost-free growing season is 5 1/2 months in the north and 7 months in northern Arkansas.

In the lower Ohio Valley where pin oak does best, the average annual temperature is 55 degrees Fahrenheit; precipitation is 40 inches; snowfall, 15 to 20 inches; noon relative humidity in July, 55 percent; frost-free season, 6 months; frost penetration, 10 inches (9).

Soils and Physiography

Pin oak in natural, pure stands makes good growth on wet sites and on heavy soils with poor internal drainage. In the lower Ohio Valley and in Missouri it is about the only species that grows well on upland "flats" characterized by excessive surface wetness in the winter and spring and excessive dryness during some periods of the summer. These "pin oak flats" occur frequently on the claypan soils (Planosols) of southwestern Ohio, southern Indiana, southern Illinois, and north-central Missouri. On these flats pin oak commonly grows in nearly pure stands.

On deeper, better drained, but still heavy-textured bottomland soils, pin oak often grows in mixture with other species including bur oak, sweetgum, soft maples, elms, and other oaks. On these sites individual pin oak trees compete successfully with the other species. On deep, well-drained bottomland soils of lighter texture, pin oak is more scattered.

In many locations natural pin oak stands are normally flooded for a few days to several weeks, usually during the late winter or spring. Because the soils are usually impermeable, ponding of surface water in shallow depressions is common. This periodic flooding does not harm the trees, but one study found that permanent flooding killed pin oak in 2 to 3 years (11).



Figure 1.--Dense young stand of pin oak.

Considering soil alone, pin oak will grow on everything from deep, well-drained bottomland soils of light texture to heavy, wet, poorly drained claypan soils on upland flats. When planted as a shade tree it grows well even on relatively dry, clay soils. Its natural occurrence is limited by competition from other trees on the good bottomland and upland sites and by lack of moisture on the drier sites. It persists in nearly pure stands over large areas because of its high vigor on wet, shallow, often-flooded soils of heavy texture.

Pin oak characteristically occurs on flat or nearly flat land. It rarely occurs on sloping or hilly uplands or at elevations higher than 800 feet.

Associated Species

As has been said, pin oak typically grows in pure even-aged stands. It is included in the pin oak-sweetgum type of the Society of American Foresters (8). When in mixture, the chief tree associates are red maple, overcup oak, elms, green ash, bur oak, hackberry, waterlocust, and honeylocust. Other associates are sweetgum, cherrybark oak, willow oak, swamp white oak, river birch, and boxelder. Sweetgum, red maple, and several oaks including cherrybark, swamp chestnut, willow, overcup, and bur, occur chiefly as associates in the southern part of the range of pin oak. Subordinate species in "pure" stands of pin oak are commonly cherrybark oak, sweetgum, willow oak, bur oak and overcup oak. American beech sometimes occurs as a subordinate in pin oak upland flats.

There are apparently no specific shrubby or herbaceous indicators for pin oak sites. Some plants, however, such as the trumpetcreeper (Tecoma radicans) and buckvine (Ampelopsis arborea), are commonly associated with pin oak.

LIFE HISTORY

Seeding Habits

Flowers of pin oak appear with or just after the new leaves, from very early April to mid-May, depending on the latitude. Staminate and pistillate flowers are borne on the same tree but cross-fertilization is probably common. Acorns develop in 16 to 18 months, ripen and fall in September, October, and November, and germinate the following spring (7, 10).

No completed studies of pin oak acorn yields or seeding habits are known, but some observations and seed collections indicate that trees may bear good crops every 2 or 3 years. Some acorns will normally be produced every year. It is estimated that large, open-grown trees may yield 25,000 or more acorns in a single year; forest-grown trees with narrow crowns will presumably produce only a small fraction of this number. Trees normally bear seed between the ages of 40 and 80 years (10), although open-grown trees will often produce seed as young as 20 years.

Seed is disseminated by water, wind, gravity, squirrels, and birds. Although sound acorns do not float, floodwaters undoubtedly carry acorns for at least a few hundred feet. The fact is that pin oak does become well distributed over wide areas. This has occurred in the Mingo Swamp of southeastern Missouri following heavy cutting and fire. The old-growth climax forests contained pin oak as scattered individuals.

Vegetative Reproduction

Pin oak sprouts vigorously from stumps of small trees. Seedling sprouts and sprouts of low origin usually develop into good trees. Where larger products are cut, such as sawlogs, satisfactory reproduction must come from seed or seedling sprouts.

Seedling Development

Pin oak acorns germinate in the spring when the soil is moist and temperatures range from 75 to 90 degrees Fahrenheit during the day and 55 to 70 degrees at night. Germination capacity is usually good, averaging about 70 percent of the sound seeds (10). Under favorable conditions shoot growth of pin oak seedlings starts at about the time of leafing out and continues throughout the summer.

Because of the abundance of seed, its wide dissemination, and the usually favorable site conditions in the spring, it is not uncommon to see the forest floor under a pin oak stand virtually a green carpet of seedlings. These seedlings, however, may be short lived. They are often killed either by a prolonged flood of muddy water during that same spring or summer, or by overtopping during the next 2 or 3 years if the overstory canopy is complete. On the other hand, seedlings in openings that receive full sunlight for at least a third of the day will usually grow rapidly and are soon out of danger of complete submersion by floodwaters. Pin oak seedlings require cleared areas or large holes in the canopy and will not survive under shade.

On pin oak sites soil moisture is not usually limiting for seedling survival. Occasionally, however, severe summer droughts kill young seedlings, especially on upland "pin oak flats."

Sapling Stage to Maturity

Growth and Yield

Pin oak grows fast (6). Thirty-year-old dominant and co-dominant trees in southeastern Missouri averaged 10 inches in diameter. With plenty of growing space, pole- and small sawtimber-sized trees often grow 4 to 6 inches in a decade.

Height growth is also rapid. A 37-year-old stand in southwestern Illinois had attained a height of 70 feet (5). On heavy, wet soils, well-stocked, even-aged stands will normally reach a height of 70 to 90 feet and a diameter of 2 feet before growth decreases sharply or the stands begin to break up. On better sites in mixed stands, pin oak trees will often reach a height of 120 feet and a diameter of 3 feet.

An even-aged, unmanaged stand in southwestern Illinois at 37 years of age had 1,500 cubic feet of merchantable wood (5). Net growth on thinned plots was 125 cubic feet per acre annually. At age 40 these stands had 3,000 board-feet per acre in trees 11 inches and larger and were growing 300 to 500 board-feet per year. It is estimated that typical 60- to 70-year-old stands will contain 8 to 12 thousand board-feet of merchantable sawtimber per acre.